GENERIC LIMITS IN THE XEROTEAE (LILIACEAE SENSU LATO)

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THE GENUS *Lomandra* Labill., variously placed in the Liliaceae Juss. (e.g., Engler, 1888; Krause, 1930), Juncaceae Juss. (Bentham, 1878, 1883), Xanthorrhoeaceae Dumort. (Melchior, 1964; Airy Shaw, 1973; Hutchinson, 1973), or Lomandraceae Lotsy (including *Xanthorrhoea*; Lotsy, 1911), currently contains about forty-three species. Forty-one of these species are endemic to Australia, growing mostly in the south and east, one species, *L. banksii*, is known from Australia (Queensland), New Caledonia, and southern New Guinea, while a single species, *L. papuana*, has hitherto been known from a single collection made in northeast New Guinea.

During a collecting trip with Y. Lelean (Division of Botany, Lae, Papua New Guinea) in the mountains of New Britain in 1973, the author was fortunate enough to collect a rather inconspicuous liliaceous plant with the facies of a species of *Dianella*, but with asymmetric, capsular fruits; another collection was made independently by J. Croft and P. Katik. This plant could not readily be placed in a genus, but Professor C. G. G. J. van Steenis, of Leiden, drew my attention to *Aet & Idjan 24*, from West New Guinea, obviously the same taxon as the New Britain plant, and identified as *Lomandra*. The New Britain and West New Guinea plants were found to be conspecific with *L. papuana*, a species hitherto known only from a single fruiting collection made in the Madang Province of Papua New Guinea. Lauterbach (1913) tentatively assigned *L. papuana* to section EULOMANDRA (correctly LOMANDRA) series Sparsiflorae. The unusual characters of *L. papuana*, which had caused my initial difficulties in naming the plant, prompted a survey of the differences between *Lomandra* and related genera, the results of which are presented below.

GENERA ASSOCIATED WITH LOMANDRA

Seven genera have often been associated with *Lomandra* in whatever family it has been placed: *Acanthocarpus* Lehm. (1 species), *Chamaexeros* Bentham (3 species), *Baxteria* R. Br. (1 species), *Calectasia* R. Br. (1 species), *Dasypogon* R. Br. (2 species), *Kingia* R. Br. (1 species), and *Xanthorrhoea* J. E. Sm. (ca. 15 species).

Bentham (1878) divided these genera among three tribes in the Juncaceae. The Xeroteae Bentham, including *Xerotes* (a synonym of *Lomandra*), *Chamaexeros*, and *Acanthocarpus*, were characterized by the small perianth, usually scarious or hyaline, rarely petaloid; dorsifixed anthers; and 3-celled ovary with one laterally attached ovule per loculus. The Xanthorrhoeae Bentham included *Xanthorrhoea* and *Dasypogon*, and were distinguished by the perianth, of which the outer whorl was glumelike and

the inner whorl thin and scarious or petal-like; the dorsifixed anthers; the variable ovary; and the stem, which was either short, thick, and hard, or elongated and woody. The Calectasieae Bentham, including *Kingia*, *Baxteria*, and *Calectasia*, were distinguished by the rigid, sometimes colored, perianth; the basifixed anthers; and the ovary, which had three ovules. Subsequent classifications are variations of this arrangement.

Bentham (1883) merged the Xanthorrhoeae with the Xeroteae. The classification of Engler (1888; in the Liliaceae, subfamily Asphodeloideae), followed that of Bentham, except that *Dasypogon* was the sole genus in a new tribe, the Dasypogoneae, characterized by a 1- or incompletely 3-locular ovary, basally attached ovules, and a single-seeded, indehiscent fruit. In the Lomandreae, which had the circumscription of the Xeroteae *sensu* Bentham (1883), *Chamaexeros* was included in *Acanthocarpus*; the Calectasieae were unchanged. Krause (1930) followed Engler, but reinstated the genus *Chamaexeros*; Fitzgerald (1903) had earlier removed *Xerotes turbinata* Endl. to a monotypic genus, *Hensmania* Fitzgerald, which Krause (1930) included in the Liliaceae-Asphodeloideae-Johnsonieae.

Fahn (1954, 1961) examined the leaf anatomy, and, less comprehensively, the anatomy of the stem and root, of a great majority of the species in the eight genera, and suggested that the genera fell into four groups: *Lomandra-Chamaexeros-Acanthocarpus*, *Xanthorrhoea*, *Dasypogon-Calectasia*, and *Kingia-Baxteria*. However, he included *Hensmania* in *Lomandra* (as *L. turbinata*), but did not find anything distinctive in its anatomy, so his conclusions should be treated with caution.

A recent palynological survey of forty-two species from all eight genera (Chanda & Ghosh, 1976) shows a very considerable range of variation of the pollen both between and within (especially in *Lomandra*) the genera. Chanda and Ghosh also recognized four groups of genera; these were, however, mostly differently circumscribed from those of Fahn. Although they placed *Lomandra*, *Chamaexeros*, and *Acanthocarpus* together, they noted that *L. micrantha*, *L. leucocephala* subsp. *leucocephala*, and *L. endlicheri* should be excluded from the Lomandraceae (i.e., the rest of *Lomandra* plus the two other genera) on palynological grounds (*op. cit.*, p. 550), and placed with *Aphyllanthes* of the Liliaceae, an advanced member of the family (see also Erdtman, 1966). They did not consider morphological characters, but noted that the groups that they recognized did not correlate very well with those recognized by Fahn (1954, 1961) on anatomical grounds.

Other recent work on these genera is that by Lee (1966, 1972), who described a few taxa in *Lomandra* and *Xanthorrhoea*, and Kuchel (1976), who described a third species in *Chamaexeros*. Burbidge (1963) and Airy Shaw (1973) recognize the same genera as did Bentham (1878). Hamann (1961, pp. 712–714) briefly discusses the relationships of the Xanthorroeaceae.

All eight genera agree in their xeromorphic facies and their often rather tough perianth parts; in addition, the stem tends to be stout and erect. However, there is considerable variation in inflorescence, in details

of the perianth, and in stamens, ovary, and fruit, as well as in anatomy (Fahn, 1954, 1961) and palynology (Chanda & Ghosh, 1976). These genera may not all be particularly closely related, but *Lomandra*, *Chamaexeros*, and *Acanthocarpus* are three genera which appear to be related and which have a number of characters in common.

Plants in these three genera are usually rather small, although of varied habit. The inflorescence is many flowered. The tepals are small, often rather tough (but not woody), usually similar in shape and size, and persistent at the base of the capsule, becoming indurated. The six anthers are dorsifixed. The completely 3-locular ovary has one, rarely two, ovules attached to the middle of the axis of the ovary (in one species at the apex); the style is not inflated. The 1- to 3-seeded capsule is loculicidal. The seeds have a thin, dull, brown to yellowish brown testa which is often finely reticulate because of the prominence of the anticlinal cell walls (FIGURE 5), and the endosperm, although oily, is tough. The micropyle faces the bottom of the ovary loculus, 90° from the point of attachment of the seed to the placenta (this position will be called basal, since the micropyle is at the bottom of the long axis of the seed). The embryo is straight or slightly curved. There is also substantial agreement between the genera in lamina anatomy. The palisade mesophyll, when present, is bifacial, and there are raphides in some cells. The fibers surrounding the vascular bundles join the epidermis on at least one side of the lamina in all except two species, the vascular bundle as a whole being dorso-ventrally elongated in all species. There is no lignified hypodermis (details from Fahn, 1954, 1961; Kuchel, 1976).

Xanthorrhoea, one of the genera that has been included in the same tribe as *Lomandra*, differs from the *Lomandra* group in several characters. *Xanthorrhoea* is often quite a large plant, and the base of the leaf widens abruptly (rare in the *Lomandra* group). The inflorescence structure is very complicated (Waterhouse, 1967), but the ultimate bracts lack the regular arrangement of those of species of the *Lomandra* group (see below). The inner perianth whorl is somewhat larger and more petaloid than the outer, a condition rare in the *Lomandra* group, although occurring there (e.g., in *L. juncea*). The seed has a black, crustaceous, almost shiny, and minutely bullate testa; the embryo lies almost horizontally across the seed, being only slightly curved in the vertical plane. The anatomy of the lamina is very distinctive. The hypodermis is sclerified, and the center of the leaf is filled with pithlike tissue. In this pith are radially arranged (i.e., as in the stem), V-shaped vascular bundles with phloem occupying the arms (see Fahn, 1954, 1961). Chromosome numbers in *Xanthorrhoea* are consistently $n = 11$; those of *Lomandra* are more variable (Briggs, 1966), being based on $n = 7$ and $n = 8$ (Lee, 1966). Chromosome numbers in other genera of the Xeroteae are unknown.

Dasypogon, the other genus which has been included in the Xeroteae, has a capitate inflorescence superficially similar to that of some species of *Lomandra*, but with a different arrangement of bractlike structures and flowers (compare FIGURE 2, b, with FIGURE 4, g, h). There are major

differences in the flower: the tepals are large, the outer three being connate and woody toward the tips while the inner three are free and rather delicate (in *Lomandra*, any connation of the tepals affects both series); the ovary is imperfectly 3-locular, with 3 basal ovules; the style is swollen. The fruits are reported to be 1-seeded and indehiscent (Bentham, 1878). In anatomy, *Dasypogon* differs from members of the *Lomandra* group: it lacks raphide cells in the mesophyll, it has only abaxial palisade tissue, and it has vascular bundles in groups of three surrounded by a common fiber sheath, the whole being more or less circular in transverse section and not reaching the epidermis (Fahn, 1954, 1961).

The other genera which have consistently been placed near *Lomandra*, but not in the same tribe, are also markedly different from the *Lomandra* group in anatomy (Fahn, 1954, 1961) and in many details of inflorescence, flower, and fruit. *Hensmania turbinata* (Endl.) Fitzgerald, once included in *Xerotes* (see above), differs from the genera once included in the Xanthorrhoeaceae in having a fleshy perianth, only three stamens with the thecae separated by a broad connective, and black, nitid, carunculate seeds with a soft endosperm. The monotypic genus *Aphyllanthes* (*A. monspeliensis* L. is the only species), which Chanda and Ghosh (1976) considered to be similar in pollen type to *Lomandra micrantha*, *L. leucocephala* subsp. *leucocephala*, and *L. endlicheri*, is also a very different plant from both the Xanthorrhoeaceae as a whole and the *Lomandra* group in particular. The individual flowers of the solitary to 3-flowered, capitate inflorescence are surrounded by a spiral involucre of 4 to 5 "bracts" that are connate at the base. The perianth is large, brightly colored, and fleshy, and the black seeds have a minutely bullate testa and a soft endosperm. *Aphyllanthes* also has bisexual flowers, a long style, and a stigma that has three spreading (rather than recurved) lobes, all additional differences between it and the three species of *Lomandra* mentioned, as well as most other species of the genus (see below).

Lomandra papuana, however, agrees with all the details in the description given above for members of the *Lomandra* group, except that its embryo is strongly curved, and so further discussion will be restricted to a comparison of *L. papuana* with *Lomandra*, *Chamaexeros*, and *Acanthocarpus*. Unqualified mention of *Lomandra* may be taken to include all species currently included in the genus *Lomandra* except *L. papuana*; the Xeroteae will be used to refer only to these four taxa, essentially the same circumscription as when it was originally used (Bentham, 1878).

VARIATION OF CHARACTERS AT THE GENERIC LEVEL WITHIN THE XEROTEAE

The main morphological differences between *Lomandra papuana*, *Chamaexeros*, *Acanthocarpus*, and the other species of *Lomandra* are summarized in TABLE 1. The characters are discussed below, and the anatomy of *L. papuana* is described.

TABLE 1. **Variation of some characters in Lomandra, L. papuana, Chamaexeros, and Acanthocarpus.***

CHARACTER	*Lomandra*	*Chamaexeros*	*Acanthocarpus*	*Lomandra papuana*
LEAF MARGIN	prickly, rarely scarious or almost smooth	scarious	prickly	smooth
LEAF BASE AURICULATE	rarely	−	+	−
FLOWER CLUSTERS IN INFLORESCENCE CLEARLY CYMOSE	+ −	−	+	+
FLOWER TYPE ON SINGLE PLANT	usually [♂], [♀] rarely [☿], [♂ ♀], [☿ ♂], or [☿ ♀]	☿	☿	☿
STIGMA PROMINENTLY RECURVED-TRIFID	+	−	−	−
STYLE LESS THAN TWICE AS LONG AS OVARY	+	−	−	+
NUMBER OF OVULES PER LOCULUS	1	2	1	2
POSITION OF OVULES IN LOCULUS	median	median	near apex	median
SEED FOVEATE	−	−	−	+
EMBRYO ± STRAIGHT, MICROPYLE BASAL	+	+	+	−
FRUIT WITH SPINES	−	−	+	[−]

* Explanation of symbols: +, character state as mentioned; −, character state other than that mentioned; [−], character state approaching that mentioned.

LEAF MARGIN. *Lomandra papuana* has a leaf without papillae, spines, or scarious margin (this last is present only at the base). All species of *Chamaexeros* have a white, scarious margin to the leaf that runs the length of the leaf, as does *L. leucocephala* (especially prominent in subsp. *leucocephala* — the decurrent leaf base of Lee, 1966), but there is an important difference between them. *Chamaexeros* lacks fiber strands in the leaf margin. The margins of *C. fimbriata* and *C. macranthera* consist of polygonal cells adjacent to the green part of the leaf and an irregular fringe of cells elongated at right angles to the leaf; the margin of *C. serra* consists almost entirely of the latter type of cells. *Lomandra leucocephala*, on the other hand, has fiber strands in the leaf margin, and the rest of the cells are elongated parallel to the long axis of the leaf. The closest approach to the *Chamaexeros* type of leaf margin in *Lomandra* perhaps occurs in species like *L. sororia*. That species has small, earlike flaps of tissue along the leaf edge; these flaps have cells elongated at right angles to the long axis of the leaf.

LEAF BASE. Auriculate leaf bases are rare in *Lomandra*, although they occur in *L. obliqua* (Lee, 1972, *figure 1*); normally the leaf widens only gradually toward the base.

INFLORESCENCE TYPE. No previous attempt has been made to interpret the inflorescences in the Xeroteae, mainly because of their great reduction and numerous parts. The diagrams given here must be considered merely as a preliminary contribution to the subject, based as they are on rather limited observations of herbarium material; developmental studies are sorely needed.

The nomenclature of the parts is a rather difficult question. Lee (1966) used the term "cluster bracts" for pointed, leaflike bracts subtending both branches and clusters of flowers, and "bracts" for all the other structures. This is somewhat of an oversimplification. In a large cluster of flowers, there may be all intermediates between leaflike bract structures (cluster bracts) and broad structures rounded at the apex (see also Lee, 1966, p. 16). These broader bractlike structures may split down the middle (see also Lee, 1966), resulting in two apparently independent bracts; Arber (1925) gives details of the effect that pressure during development may have on the shape of prophylla in monocotyledons, although it should be noted that Stebbins (1974, and references therein) has a different interpretation of prophylla. In some cases the terminal cluster of flowers may lack cluster bracts, while the clusters along the stem may be subtended by them (e.g., *Lomandra banksii*, *L. multiflora*). The terms "bract" and "bracteole" are impossible to use confidently for similar reasons; there may be a variable number of "bracts" surrounding the flower, and the "bract and bracteole" of a flower may turn out to be the lowest two bracts surrounding the single flower of a reduced cymose inflorescence. There are sometimes irregular changes in the position of insertion of the

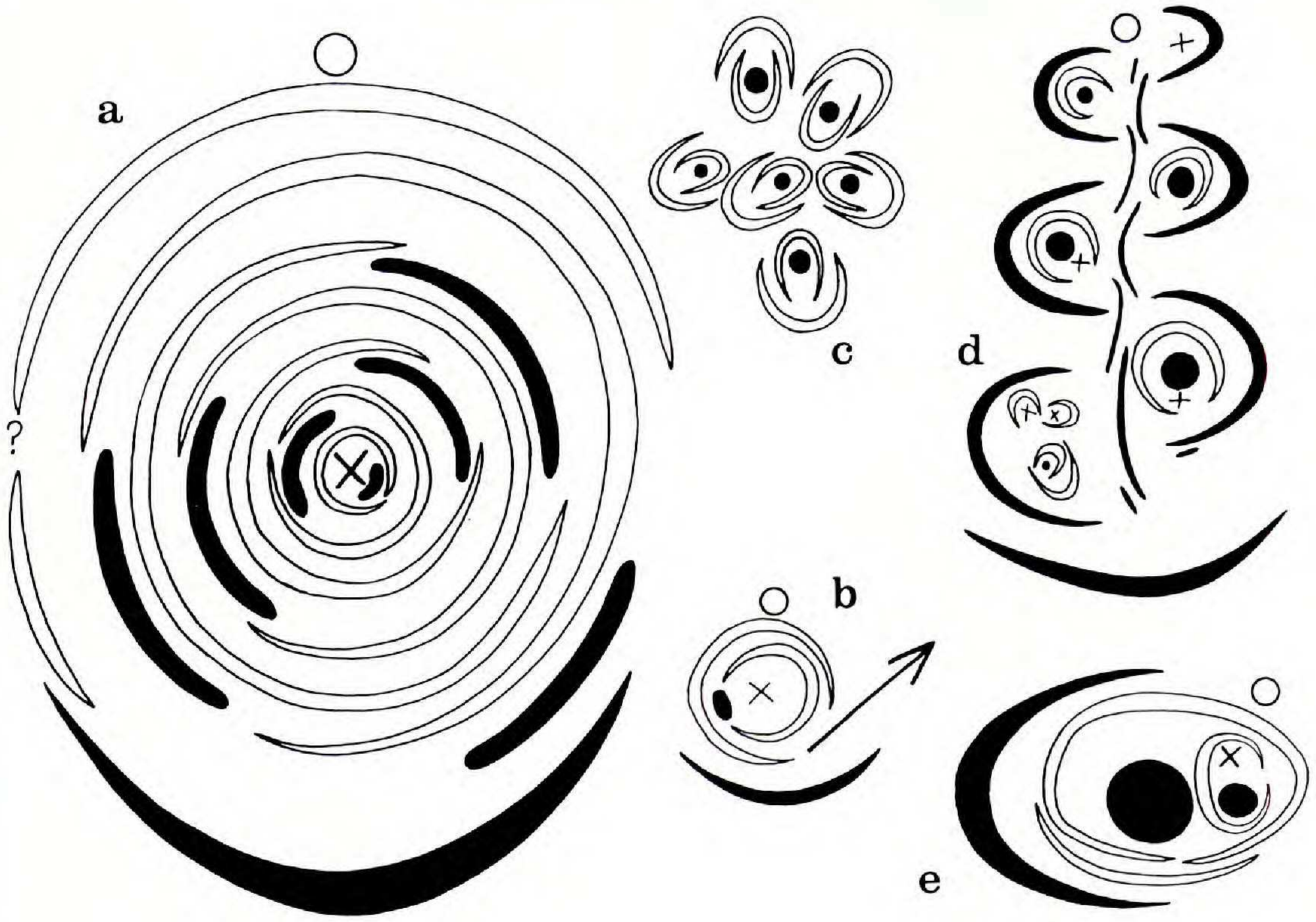

FIGURE 1. Inflorescence structure (diagrammatic). a, b, *Lomandra papuana*: a, axillary flower cluster (*NGF 41283*); b, axillary cluster showing origin of a lateral branch (*NGF 41283*). c, *Chamaexeros fimbriata*, terminal cluster (*Salisbury 31*). d, e, *Lomandra hastilis*; d, axillary cluster near top of inflorescence (*George s.n.*, 11 July 1961); e, subcluster from axillary branch near base of inflorescence (*Canberra Botanic Gardens 22976*, coll. *Philips*, 23 Oct. 1972). (Filled crescents = cluster bracts; unfilled crescents = bractlike structures; filled circles or ovals = flowers; unfilled circles = inflorescence axis; parallel lines = axis of cluster; arrow = inflorescence branch; x = structure unclear.)

various bractlike structures (see FIGURES 1, a; 2, a), but these must be treated with caution because of distortions in the dried material.

This being said, it has been possible to establish some taxonomically important variation in inflorescence type. The terms "bract," "bracteole," and "cluster bract" are used despite the caveats entered above. The term "cluster bract" denotes a bractlike structure that subtends a cluster of flowers along the stem, although the cluster may be reduced to a single flower.

Lomandra papuana Lauterbach. The inflorescence axis is fairly long (about 30 cm.) and is irregularly branched. There are small flower clusters both at the branching points and along the unbranched axis, especially toward the apex; the clusters are subtended by cluster bracts. These clusters are clearly cymose (FIGURE 1, a) and consist of bracts which successively subtend and enclose both the terminal flowers and the rest (the younger part) of the cluster. In the clusters dissected, the flowers arose along three axes; although alternation between the axes was not always regular, this may have been caused by distortion of the dried ma-

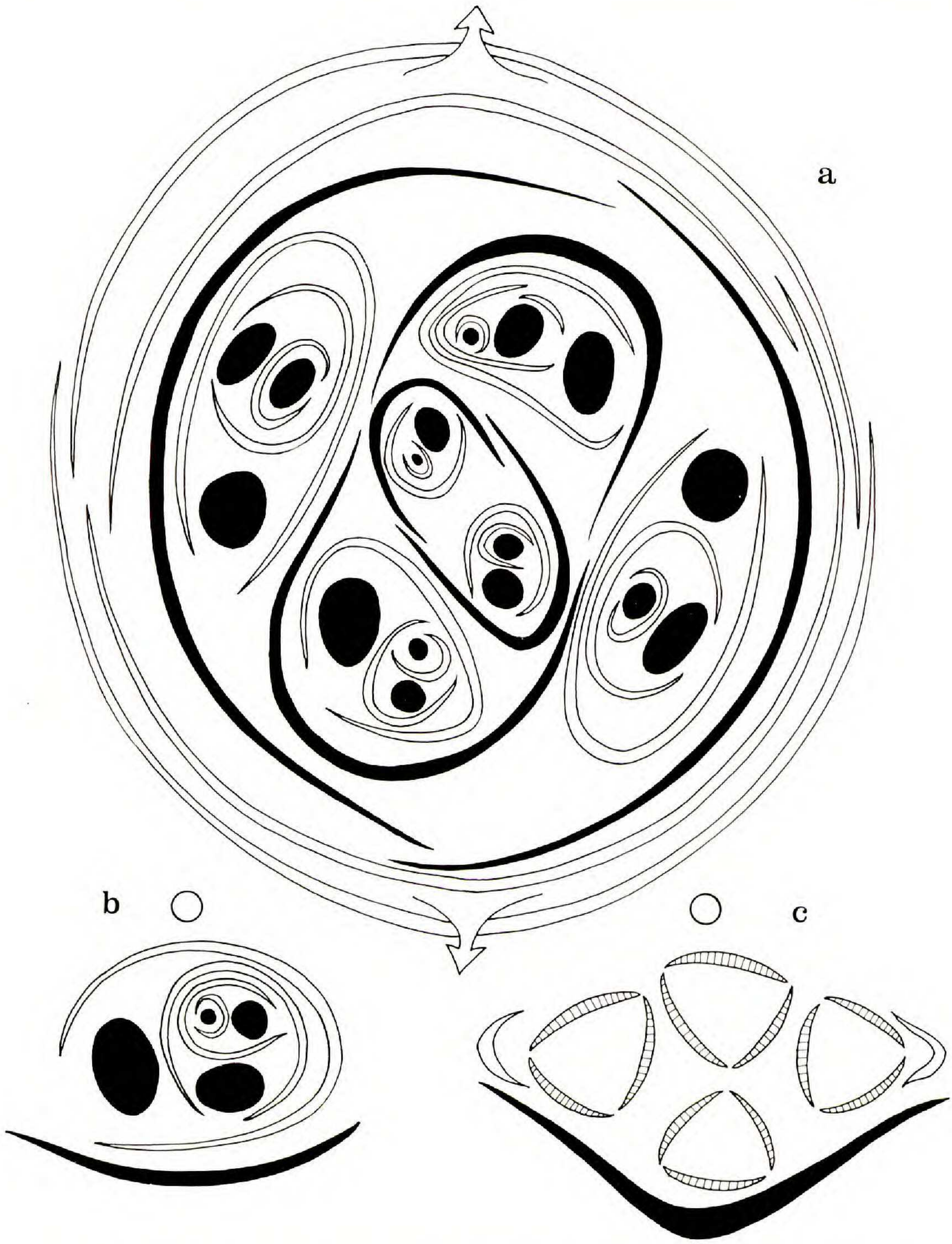

FIGURE 2. Inflorescence structure (diagrammatic). a, b, *Acanthocarpus preissii*: a, complete terminal inflorescence (*Drummond 304*); b, lowermost flower cluster of well-developed inflorescence (*Drummond 304*). c, *Dasypogon hookeri*, flower cluster (*Wilson 274*). (Filled crescents = cluster bracts; unfilled crescents = bractlike structures; crosshatched crescents = outer whorl of tepals; filled circles = flowers; unfilled circles = inflorescence axis; arrows = vegetative shoots developing from axillary buds.)

terial. Branches with racemose growth bearing further cymose clusters may develop from within the cluster (FIGURE 1, b). Each cluster is clearly long-lived, flowers probably developing successively for more than

six months, with pedicels of fallen fruits, ripe fruits, and flowers occurring in the one cluster.

Acanthocarpus. The inflorescence in the sole species of the genus, *Acanthocarpus preissii* Lehm., is basically similar to that of *Lomandra papuana*. However, the inflorescence axis is very short, and what appears to be a single, terminal cluster is in fact made up of several clusters (FIGURE 2, a), each with a cymose structure. The cymose structure of the individual clusters is clearly seen in the larger inflorescences (FIGURE 2, b). The inflorescences are not notably long-lived. As in *L. papuana*, the whole inflorescence is racemose, and the youngest clusters are borne in the distal part of the inflorescence.

Chamaexeros. *Chamaexeros macranthera* Kuchel, *C. serra* (Endl.) Bentham, and *C. fimbriata* (F. Mueller) Bentham have similar inflorescence structures, although superficially they are very different. The flowers are aggregated into clusters, each flower being surrounded by two bractlike structures, possibly bract plus bracteole, inserted opposite each other (FIGURE 1, c). No cluster bracts associated with the flower clusters were seen, but there are bracts along the inflorescence axis of *C. serra* which subtend the branches of the inflorescence.

Lomandra.[1]

Lomandra section CEPHALOGYNE (Bentham) Engler. The inflorescence structure in species of this section is very uniform. Each flower is subtended by two bractlike structures, "bract" plus broad, opposite or subopposite "bracteole," with or without associated cluster bracts. Pistillate inflorescences consist of a single, terminal head, and the cluster bracts subtend 1 to 4 flowers (FIGURE 4, c–e; note orientation of flower in FIGURE 4, e); in staminate inflorescences there are several clusters of flowers along the inflorescence axis, generally with associated cluster bracts (FIGURE 4, h), while the terminal clusters of flowers may lack cluster bracts. Both the clusters and the inflorescence axis in section CEPHALOGYNE appear to be racemose.

Species examined: *Lomandra elongata* (Bentham) Ewart, *L. glauca* (R. Br.) Ewart subsp. *glauca* and subsp. *collina* (R. Br.) A. Lee, *L. obliqua* (Thunb.) Macbride, *L. rupestris* (Endl.) Ewart, *L. suaveolens* (Endl.) Ewart.

[1] Bentham (1878) described *Xerotes* section SCHOENOXEROS Bentham (= *Lomandra* section SCHOENOLOMANDRA Engler) because it was thought that the barren stems of the included species (*L. spartea, L. juncea*) were rushlike, while the fertile stems had only sheathing scales at the base. These so-called stems are leaves (see also Fahn (1954), who was unaware of speculations as to the nature of these organs, but who found no anatomical characters leading him to doubt that they were leaves), and often have a small sheath at the base. Similar terete leaves may also be found in *L. cylindrica, L. sororia*, and *L. micrantha* (also noticed by A. T. Lee, pers. comm.). *Lomandra spartea* will be discussed under section LOMANDRA; *L. juncea* under section TYPHOPSIS. Both *L. spartea* and *L. juncea* have inverted vascular bundles in the leaf (see Fahn, 1954), but it is not known whether the terete leaves of these other (unrelated) species also have such inverted bundles. *Lomandra dura*, with flat leaves, has inverted bundles.

Lomandra section MACROSTACHYA (Bentham) Engler. The inflorescence is a "spike" bearing numerous condensed spikelet-like clusters. Each spikelet is subtended by a single cluster bract (FIGURE 1, d), and the flowers near the top of the spikelet appear to have a bract and a bracteole associated with them. However, even in the spikelets near the top of the inflorescence, the lower flowers are associated with more numerous bractlike structures (FIGURE 1, d), and lower down the inflorescence the bottom flower of a spikelet is replaced by a group of flowers which have a cymose arrangement of parts (FIGURE 1, e), so the "bract plus bracteole" represents a reduced, probably cymose, partial inflorescence.

Species examined: *Lomandra hastilis* (R. Br.) Ewart (the only species in the section).

Lomandra section TYPHOPSIS (Bentham) Engler. Elucidation of the inflorescence structure of the two species included here is made difficult by the fact that the bractlike structures are divided almost to the base into numerous hairs. Both species have flowers aggregated into dense heads. In *Lomandra leucocephala* the cluster bracts are prominent and subtend a number of flowers; each flower is completely surrounded by hairs which apparently represent two or more bractlike structures. In *L. juncea* the cluster bracts are less prominent, and there appear to be two bractlike structures surrounding each flower.

Species examined: *Lomandra leucocephala* (R. Br.) Ewart subsp. *leucocephala* and subsp. *robusta* Lee, *L. juncea* (F. Mueller) Ewart (possibly only superficially similar to the preceding species).

Lomandra section LOMANDRA (*Eulomandra* Engler, *Euxerotes* Bentham). There are about thirty-two species belonging to this section. Bentham (1878) placed the eighteen species that he recognized in three series, based on whether or not the flowers were in clusters and whether or not they were sessile. Most of the species that were included in *Xerotes* section EUXEROTES (properly XEROTES) series Fasciculatae Bentham and series Sparsiflorae Bentham have clusters which appear to be similar in structure (group A), although varying as to how they are disposed on the inflorescence axis (singly or in whorls). Members of series Glomeratae Bentham, as well as *Lomandra spartea* and *L. multiflora* (the last was placed in series Fasciculatae), have a somewhat different inflorescence structure (group B).

Group A. The flowers are borne singly (or mostly so) along the axis (Sparsiflorae: FIGURE 3, a–m), or in clusters which are in turn in whorls (Fasciculatae: FIGURE 3, o–w). The inflorescences of a number of the species in the former series appear to be simply racemose, with the bracteoles laterally placed (the exact position of the bracteole is uncertain — compare FIGURE 1, a, with *figures 78* and *83* in Eichler, 1875). However, further bractlike structures, and even flowers, may develop in association with these "bracteoles" (FIGURE 1, h, m, n). This suggests that the racemes and once-branched panicles of these species are derived from more complexly branched inflorescences perhaps with cymose partial in-

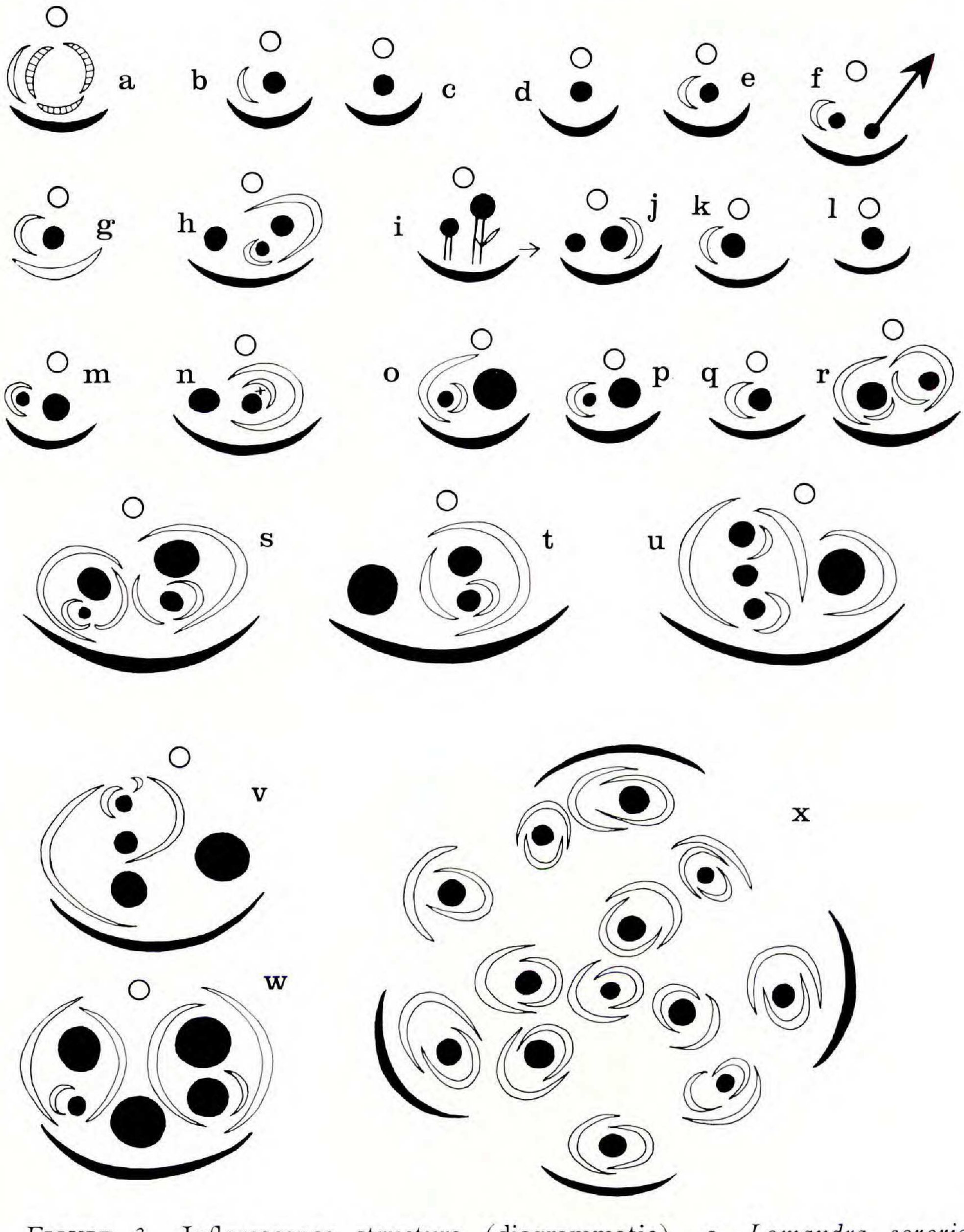

FIGURE 3. Inflorescence structure (diagrammatic). a, *Lomandra sororia*, single flower (*AD 96415025*, staminate plant). b, c, *L. cylindrica*, single flowers (*NSW 49111*, staminate plant). d–f, *L. filiformis*, single flowers: d, usual; e, rare; f, with inflorescence branch (*Clemens 44542*, staminate plant). g, h, *L. effusa*, axillary flower (clusters): g, usual; h, rare (*Pritzel 392*, staminate plant). i–l, *L. fibrata*, axillary flowers (*AD 95941052*, pistillate plant). m, n, *L. micrantha*, axillary flower clusters (*Drummond 809*, staminate plant). o–u, *L. endlicheri*: o–r, individual axillary flower clusters (*Royce 3059*, pistillate plant); s–u, three flower clusters forming a single whorl (*Pritzel 361*, staminate plant). v, *L. preissii*, axillary flower cluster (*Wilson 3728*, staminate plant). w, *L. purpurea*, axillary flower cluster (*Andres s.n.*, Oct. 1903, staminate plant). x, *L. montana*, terminal cluster (*NSW 88924*, pistillate plant). (Filled crescents = cluster bracts; unfilled crescents = bractlike structures; crosshatched crescents = outer whorl of tepals; filled circles = flowers; unfilled circles = inflorescence axis; arrows = inflorescence branches.)

florescences. The flower clusters of species in series Fasciculatae seem to be similar to, but more complex than, those of series Sparsiflorae (FIG-

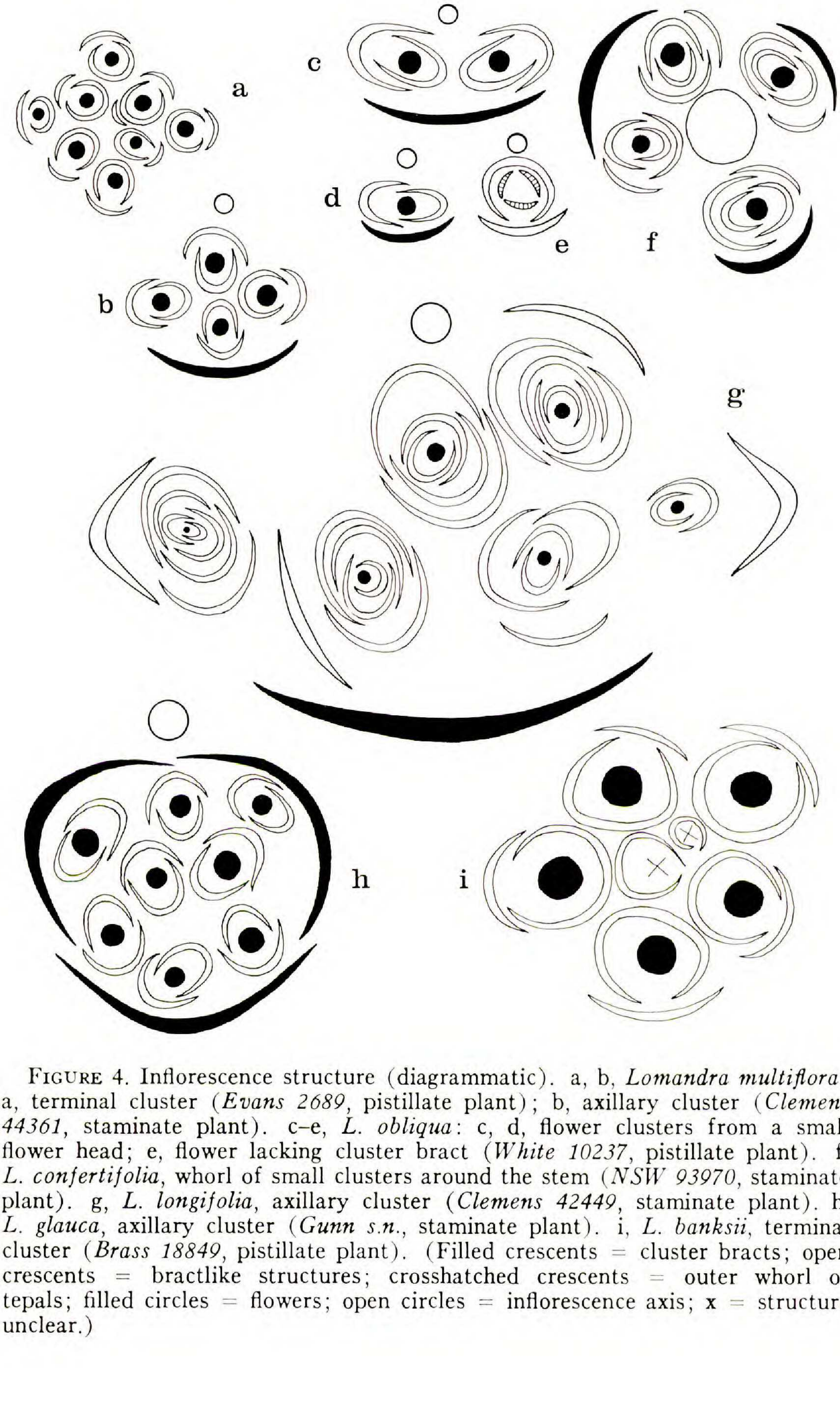

FIGURE 4. Inflorescence structure (diagrammatic). a, b, *Lomandra multiflora*: a, terminal cluster (*Evans 2689*, pistillate plant); b, axillary cluster (*Clemens 44361*, staminate plant). c–e, *L. obliqua*: c, d, flower clusters from a small flower head; e, flower lacking cluster bract (*White 10237*, pistillate plant). f, *L. confertifolia*, whorl of small clusters around the stem (*NSW 93970*, staminate plant). g, *L. longifolia*, axillary cluster (*Clemens 42449*, staminate plant). h, *L. glauca*, axillary cluster (*Gunn s.n.*, staminate plant). i, *L. banksii*, terminal cluster (*Brass 18849*, pistillate plant). (Filled crescents = cluster bracts; open crescents = bractlike structures; crosshatched crescents = outer whorl of tepals; filled circles = flowers; open circles = inflorescence axis; x = structure unclear.)

URE 3, o–w, especially o–r). In species of group A as a whole, the individual flowers are not completely ensheathed in bractlike structures, and the bracts are rather narrow and have acute tips. This contrasts with the often very broad, sheathing, innermost bractlike structures in section CEPHALOGYNE and in group B, below.

Species examined: *Lomandra bracteata* Lee, *L. brevis* Lee, *L. cylindrica* Lee, *L. densiflora* Black, *L. endlicheri* (F. Mueller) Ewart,[2] *L. effusa* (Lindley) Ewart, *L. fibrata* Black, *L. filiformis* (Thunb.) J. Britten, *L. micrantha* (Endl.) Ewart, *L. pauciflora* (R. Br.) Ewart, *L. preissii* (Endl.) Ewart,[2] *L. purpurea* (Endl.) Ewart,[2] *L. sororia* (F. Mueller) Ewart.

Group B. Species in this group have flowers in clusters grouped in whorls along the inflorescence axis. Prominent, pointed cluster bracts occur in many species, and in all species each flower is completely surrounded by bractlike structures, usually two or more in number (FIGURES 3, x; 4, a, b, f, g, i). Terminal clusters in *Lomandra longifolia*, *L. banksii*, etc., may lack cluster bracts, although these are associated with the clusters along the axis of the same inflorescence. The number of bractlike structures surrounding the flower may vary within a species (e.g., in *L. longifolia*).

Species examined: *Lomandra banksii* (R. Br.) Lauterbach, *L. dura* (F. Mueller) Ewart, *L. confertifolia* (F. M. Bailey) Fahn, *L. longifolia* Labill., *L. montana* (R. Br.) Fraser & Vickery, *L. multiflora* (R. Br.) J. Britten, *L. ordii* (F. Mueller) Ewart, *L. patens* A. Lee, *L. rigida* Labill., *L. spartea* (Endl.) Ewart, *L. spicata* A. Lee.

Summary of inflorescence variation in the Xeroteae. The inflorescences examined seem to belong to two types.

I. *Acanthocarpus* and *Lomandra papuana* have clearly cymose flower clusters, the single bract associated with each flower completely ensheathing both that flower and the younger part of the cluster. At least toward the base of the large and apparently complex inflorescence of *Lomandra macrostachya*, there are clearly cymose clusters of flowers; these clusters are borne on racemose side branches of a racemose main axis. This type of inflorescence, with cymose ultimate branch units borne on a racemose (monopodial) main axis, is common in monocotyledons (Tomlinson, 1970—see also diagrams in such books as Eichler, 1875; Stebbins (1974, p. 314) considers monocotyledons to have basically racemose or spicate inflorescences). It is also possible that the species of *Lomandra* in group A of section LOMANDRA have an inflorescence of a similar type, but much more reduced.

II. Those species in which each flower is surrounded by two or more bractlike structures (*Chamaexeros* and the rest of *Lomandra*) are not so easily related to an inflorescence with cymose clusters borne racemosely along an axis, although it is possible that each flower represents such a cymose cluster.

[2] Species with flower clusters in whorls.

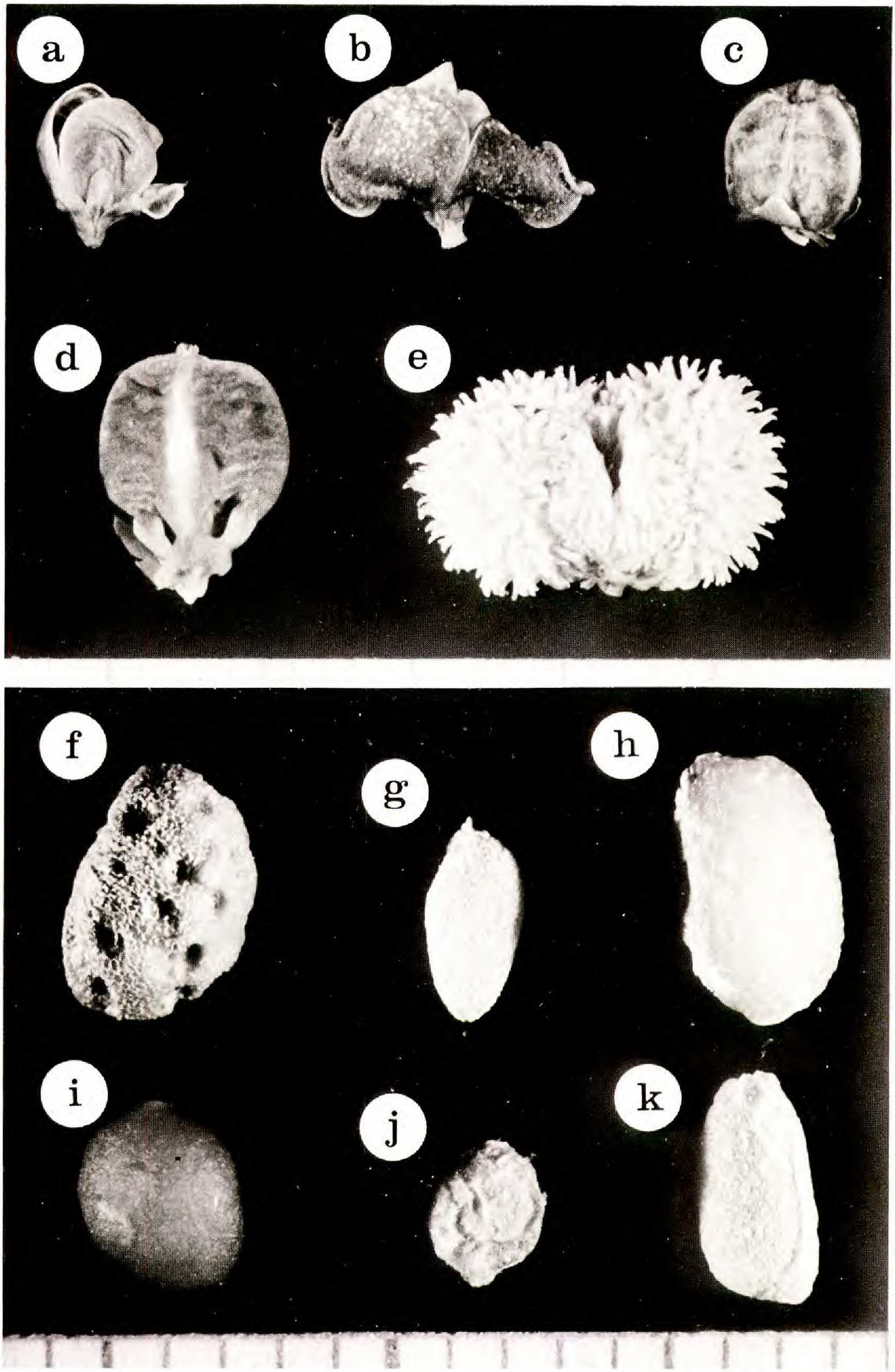

FIGURE 5. Capsule and seed type in the Xeroteae. a–e, capsules: a, *Lomandra papuana* (*Aet & Idjan 24*); b, *L. cylindrica* (*Wilkes s.n.*); c, *Chamaexeros fimbriata* (*Helms s.n.*, MEL 8378); d, *L. multiflora* (*Brass 18939*); e, *Acanthocarpus preissii* (*E. H. Wilson 300*). f–k, seeds: f, *L. papuana* (*Aet & Idjan 24*);

FLOWER TYPE. *Lomandra* has often been considered to be a genus of dioecious plants, but see Lee (1966). Perfect flowers, or flowers of the type other than that predominating on the plant, are to be found quite frequently in the otherwise staminate or pistillate inflorescences of some species (e.g., *L. bracteata*), and *L. hermaphrodita* was described from plants with perfect flowers, as its name implies. *Lomandra papuana*, *Acanthocarpus*, and *Chamaexeros* have flowers which appear to be perfect.

STIGMA AND STYLE. The stigma of *Lomandra* is characteristic, being prominently trifid with recurved lobes. The style is usually shorter than the ovary, although somewhat longer in species like *L. leucocephala*. *Lomandra papuana*, *Chamaexeros*, and *Acanthocarpus* have slender, usually long styles (but only about as long as the ovary in *L. papuana*) and very small stigmas which are not obviously 3-lobed.

OVULE POSITION. All species in the Xeroteae have 3-locular ovaries. The single, pendulous ovules of *Acanthocarpus* are borne near the top of the loculus. The paired ovules of *Lomandra papuana* are also clearly pendulous, and one is borne somewhat above the other. The ovules in *Chamaexeros* and *Lomandra* are less obviously pendulous; the paired ovules in the former genus are collateral.

FRUIT. The fruit of *Acanthocarpus* is densely covered by rather blunt spines (FIGURE 5, e); minute spines also occur near the top of the immature fruit of *Lomandra papuana*. The mature capsule of *L. papuana* is smooth (FIGURE 5, a), and in both species the young ovary is also smooth. All other taxa lack spines on both fruits and young ovaries, although the fruits may become more or less transversely wrinkled when ripe (FIGURE 5, b–d).

SEED SURFACE. *Lomandra papuana* has prominently foveate seeds, with pits penetrating the endosperm (FIGURE 5, f). The testa of a few other members of the Xeroteae may be irregularly wrinkled (FIGURE 5, g–k), but then the surface of the endosperm is smooth in all cases. *Acanthocarpus*, *Lomandra*, and *Chamaexeros* thus have similar seeds, but it should be noted that seeds of only twenty-two species of *Lomandra* and one species of *Chamaexeros* were examined (this species of *Chamaexeros*, *C. fimbriata*, is apparently the only species in the genus of which the seeds are known — Kuchel, 1976).

EMBRYO. The embryo of *Lomandra papuana* is vertical and central in position in the upper part of the seed, but then it becomes curved so that the micropyle is in the center of the outer part of the seed. In all other

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g, *L. cylindrica* (*Wilkes s.n.*); h, *L. multiflora* (*Brass 18939*); i, *A. preissii* (*E. H. Wilson 300*); j, *C. fimbriata* (*Helms s.n.*, MEL 8378); k, *L. longifolia* (*C. T. White 11612*). (Scale in millimeters.)

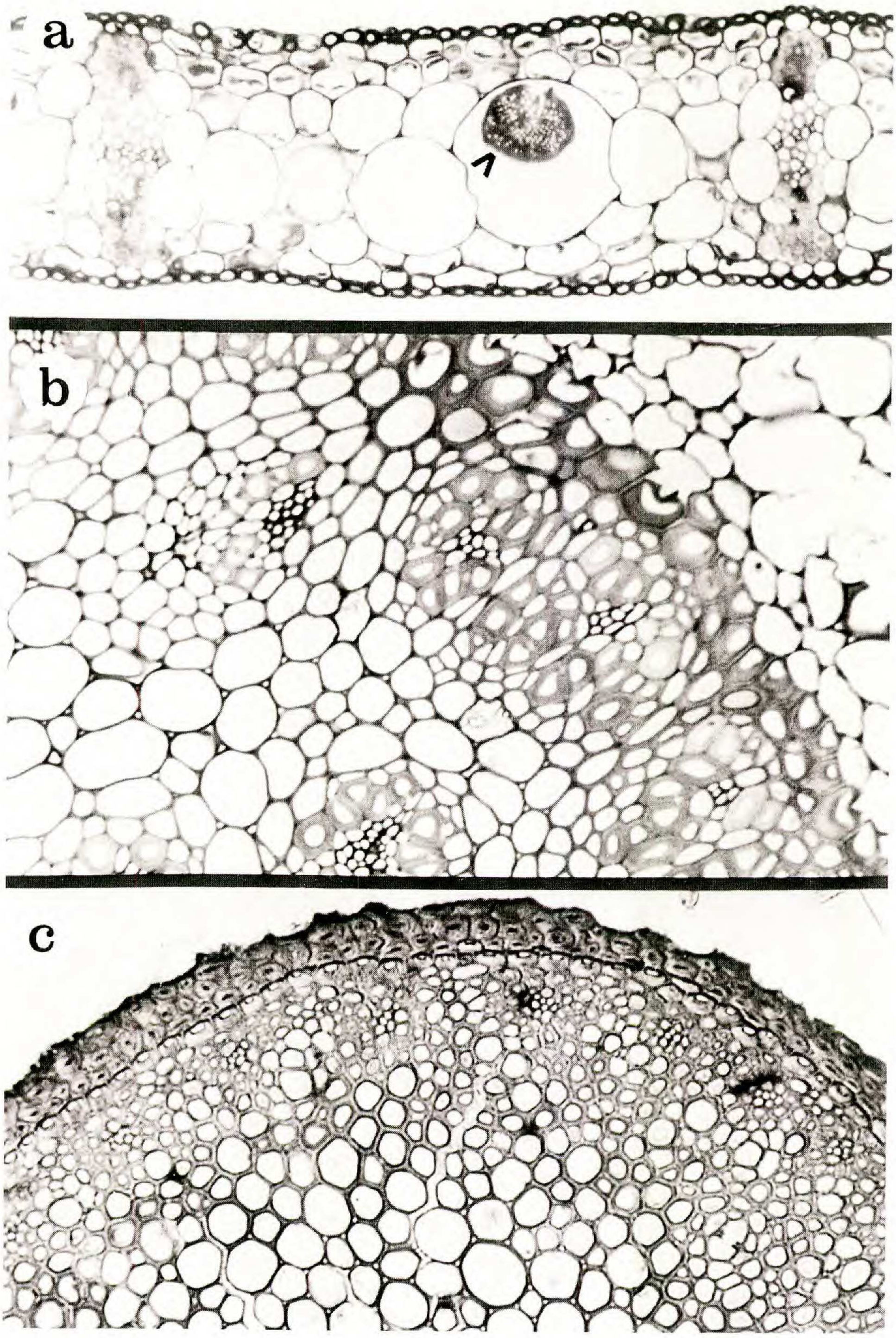


FIGURE 6. Anatomy of *Lomandra papuana*: a, transverse section of lamina, × 230 (arrow points to crystal mass); b, transverse section of rhizome, × 140 (cortex top right); c, transverse section of root, × 300. (All from *LAE 58742*; photographs courtesy of I. A. Staff.)

species of the Xeroteae in which seeds have been seen, the embryo is more or less straight for its whole length, the micropyle being near the base of the seed.

Anatomy. Dr. I. A. Staff (La Trobe University, Australia) examined the anatomy of the leaf blade and rhizome of *Lomandra papuana* (*LAE 58742*), and the description below is taken from notes that he sent. The specimens were swollen by heating in water, embedded in araldite resin, sectioned at about 2 μm., and observed with a Zeiss Standard Universal microscope.

Leaf (Figure 6, a). Thickness about 150 μm.; more or less isobilateral. Epidermal cells thick-walled, rounded. Stomata on both surfaces; guard cells and accessory cells thick-walled, the latter with a small beak bordering the pore. Hypodermis present. No clearly differentiated palisade mesophyll; the central mesophyll cells large and rounded, occasionally with a mass of crystals (birefringent in polarized light when viewed under crossed nichols) embedded in an amorphous matrix. Vascular bundle with ad- and abaxial sclerenchymatous girder extending to, but not including, the hypodermis; sheath cells noticeably smaller than the central mesophyll cells.

Rhizome (Figure 6, b). Epidermis of small, tightly packed, almost rectangular cells. Cortex parenchymatous. Endodermis with U-shaped thickenings. Vascular bundles most numerous just interior to the endodermis, amphivasal, although the xylem elements sometimes not completely surrounding the phloem. Ground parenchyma with numerous intercellular spaces. No secondary thickening observed.

Root (Figure 6, c). Mature root decorticates down to the innermost two layers of the cortex; these are heavily lignified and persistent. Endodermis heavily thickened on all walls except the outer tangential walls. Vascular tissue embedded in heavily lignified tissue close to the endodermis, with alternating areas of xylem and phloem. Pith of angular, isodiametric parenchymatous cells with numerous small intercellular spaces.

Summary of anatomical variation in the Xeroteae. From the information given by Fahn (1954) and confirmed by P. B. Tomlinson (pers. comm.), it seems that there are no major anatomical groupings recognizable within the Xeroteae; the Xeroteae themselves are separable from the other genera associated with them mainly in not having the characters that distinguish these other genera (see p. 131). Although cambium has been found in a number of species of *Lomandra* (Fahn, 1954; Staff, pers. comm.) and in *Acanthocarpus* (Tomlinson, pers. comm.), the taxonomic significance of its absence in *L. papuana* is unclear. The failure of the sclerenchymatous vascular bundle girders to reach the epidermis in *L. papuana* is uncommon in the Xeroteae, although it has been reported from *L. pauciflora* and *Chamaexeros* (Fahn, 1954). In other anatomical details *L. papuana* is similar to other Xeroteae.

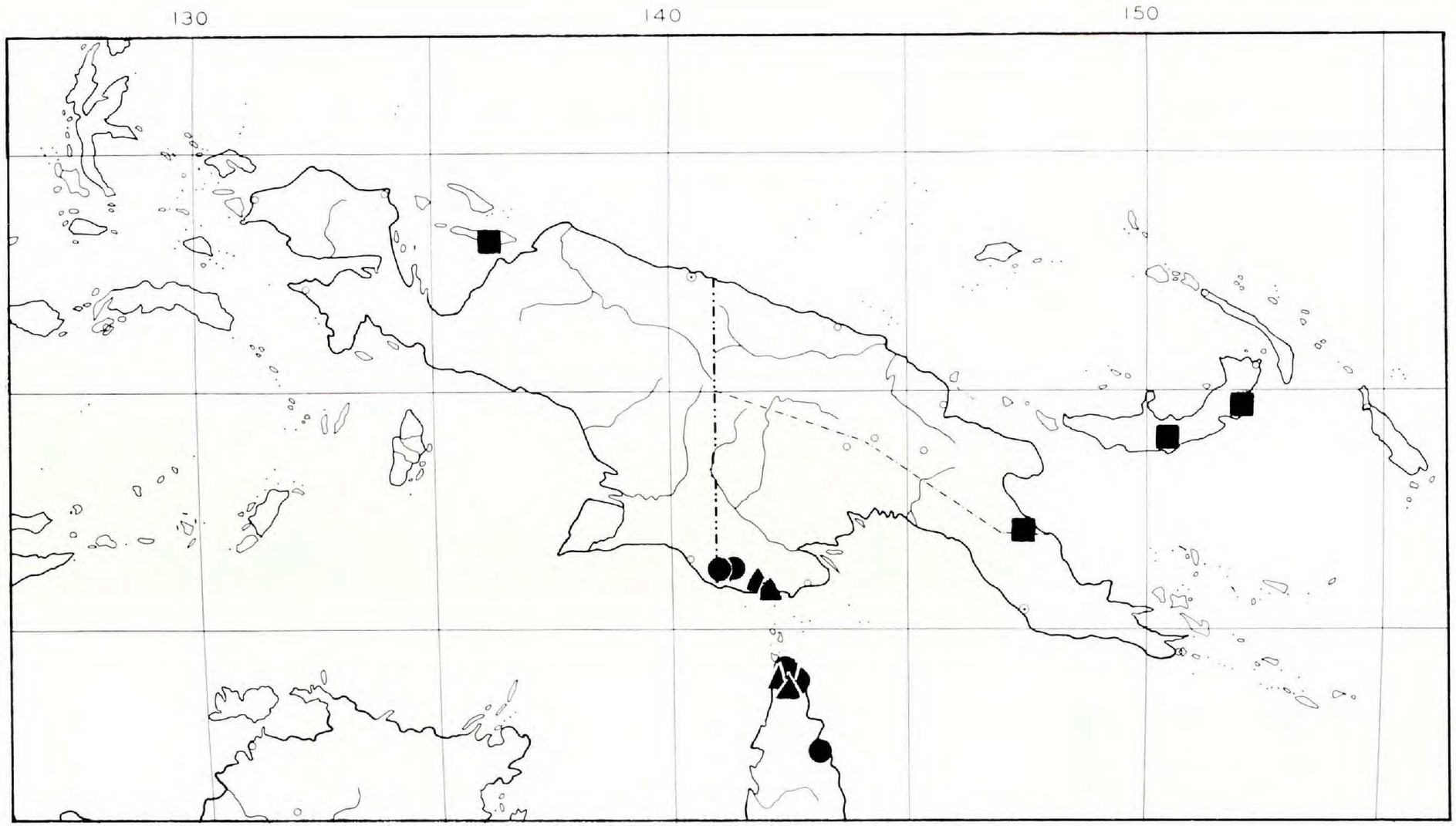
TAXONOMIC POSITION OF LOMANDRA PAPUANA

The relationships between *Lomandra papuana*, *Lomandra*, *Chamaexeros*, and *Acanthocarpus* appear to be reticulate (see especially TABLE 1). Each taxon can easily be distinguished from the others separately, but when one taxon is compared with the other three simultaneously, the distinction is less clear cut. All genera have a xeromorphic facies, and parallelism and superficial convergence obscuring taxonomic relationships in such plants are notorious.

Acanthocarpus and *Lomandra papuana* are similar in flower cluster structure, the spines or papillae on the (young) fruit, and the clearly pendulous ovules. *Acanthocarpus* can readily be separated from all other taxa in the Xeroteae by its fruit, which is spiny when mature, while *L. papuana* can be recognized by its foveate seeds and curved embryo. In facies the two are very different. *Acanthocarpus*, with its short, recurved leaves, long stem, and sessile inflorescence, approaches some members of *Lomandra* section CEPHALOGYNE (*L. mucronata* (R. Br.) A. Lee has been compared with *Acanthocarpus* (see Lee, 1972); Macbride (1918) considered it to be a species of that genus), although this growth form is uncommon in *Lomandra*. *Lomandra papuana*, with its long leaves serrate at the apex, its short stem, and its long, branched inflorescence, is similar to the majority of species of *Lomandra* in these respects.

Lomandra and *Chamaexeros* are similar in facies and inflorescence, and the diagnostic type of scarious leaf margin of the latter genus may be derived from a margin like that of some species of *Lomandra* (e.g., *L. sororia*). Variation in leaf type is comparable in the two genera: in *Chamaexeros* closely related species have either terete or flattened leaves, while in *Lomandra* there is infraspecific variation in leaf type; in both genera there are species with inverted vascular bundles in their leaves (Fahn, 1957). However, the stigma with three well-developed recurved arms which occurs in all species of *Lomandra* known to me is unique in the group; in stigma and style *Chamaexeros* approaches *L. papuana* and *Acanthocarpus*. *Chamaexeros* is usually considered to have a single ovule per loculus (see, for example, Bentham, 1878; Kuchel, 1976), but I have consistently found two ovules per loculus in all three species. All the pistillate or bisexual flowers of *Lomandra* dissected had but a single ovule per loculus.

The considerable variation in pollen type within *Lomandra* does not greatly aid the definition of generic boundaries. *Chamaexeros* (*C. serra*, *C. fimbriata*) and *Acanthocarpus* have similar boat-shaped, sulcate pollen grains, the sulcus dividing each grain into equal halves; there are no supra-tectal processes (Chanda & Ghosh, 1976). In twenty-four of the twenty-seven species of *Lomandra* that Chanda and Ghosh examined, the sulcate grains were either more or less spheroid, with supra-tectal processes, and divided by the sulcus into two equal halves, or disc-shaped, lacking processes, and divided by the sulcus into two unequal halves. However, three species, *L. micrantha*, *L. endlicheri*, and *L. leucocephala*,



MAP 1. Distribution of the Xeroteae in Papuasia and adjacent Queensland. Squares, *Romnalda papuana*; circles, *Lomandra multiflora*; triangles, *L. banksii*.

had spiraperturate or spiraperturate-type grains which Chanda and Ghosh (*op. cit.*) considered to be very different from the others. However, I know of no morphological or anatomical evidence to suggest that those three species should be placed in a genus other than *Lomandra*. (There was too little material of *L. papuana* for palynological examination in the current study.)

The variation pattern in the Xeroteae is best represented formally by recognizing four genera, *Lomandra papuana* being removed from *Lomandra* and becoming the type of the monotypic genus *Romnalda* (this generic name was chosen to emphasize the apparently reticulate nature of the relationships in the Xeroteae). *Chamaexeros*, *Lomandra*, and *Acanthocarpus* are maintained as genera; all three are natural taxa. It may be noted that if Ewart's (1916) reduction of *Chamaexeros* to *Acanthocarpus* is followed (see also Mueller, 1878; Engler, 1888), then there is no reason to keep either *Acanthocarpus* sensu lato or *Romnalda* separate from *Lomandra*, but then the resulting heterogeneity in the latter genus would not be taxonomically satisfactory.

Romnalda, from the tropical rainforests in the northern part of Papuasia (MAP 1), appears to be most closely related to *Acanthocarpus*, a genus growing in very much drier and more open conditions in sclerophyll vegetation in southwest Australia. *Romnalda* is clearly not immediately related to *Lomandra*, two species of which occur in relatively drier and open conditions in the Western Province of Papua New Guinea (MAP 1). The restriction of the Xeroteae within Malesia to the Papuasian region might be expected of such a xeromorphic, Australian-centered group, but there is clearly much work to be done before the rather puzzling relationships between members of this group are understood.

ARTIFICIAL KEY TO GENERA OF THE XEROTEAE

1. Plants usually dioecious; stigma of pistillate or the rare bisexual flowers with three prominent, recurved arms. ..... *Lomandra*.
1. Plants hermaphroditic; stigma minute, ± pin-shaped.
   2. Leaves with prominent scarious margins along their lengths (sometimes broken off in old leaves); each flower surrounded by a "bract plus bracteole." ..... *Chamaexeros*.
   2. Leaves lacking scarious margins except at their bases; each flower surrounded by only a single "bract."
      3. Inflorescence axes less than 3 mm. long; ripe capsules spiny; ovules one per loculus. ..... *Acanthocarpus*.
      3. Inflorescence axes 7–20 cm. long; ripe capsules smooth; ovules two per loculus. ..... *Romnalda*.

Romnalda P. F. Stevens, gen. nov.

A *Acanthocarpo*, *Lomandra* et *Chamaexeros* in seminibus foveatis et embryone curvato differt, a *Acanthocarpo*, quo aliter simile est, in loculis ovarii biovulatis, non uniovulatis, axe inflorescentiae elongato, non brevi, et capsula matura laevi, non echinata, a *Chamaexeros* in inflorescentia et

margine foliae, et a *Lomandra* in stylo stigmateque et numero ovularum differt.

Herba caule breve. Folia longa, apice serrata. Inflorescentia axe elongato; flores in cymulis densis aggregatis. Flos hermaphroditus; tepala tenacia, persistentia; stamina 6, antheris dorsifixis; ovarium 3-loculare, loculis ovulis duabus pendentibus plus minusve superpositis provisum; stylus longus; stigma parvum. Capsula loculicida 1–3-seminalis; semen foveatum, endospermio oleoso tenaci, embryone curvato, micropylo pagina extus inter medium basinque testae praesenti.

TYPUS (et species sola): *Romnalda papuana* (Lauterbach) P. F. Stevens.

THE PAPUASIAN XEROTEAE

Romnalda papuana (Lauterbach) P. F. Stevens, comb. nov.

Lomandra papuana Lauterbach, Bot. Jahrb. **50:** 294. 1913; Krause, Bot. Jahrb. **59:** 554. 1925. TYPE: [Papua New Guinea, Morobe Province] Goromia, 250 m., 8 March 1908, *Schlechter 17396* (holotype, B; isotype, WRSL).

Herb, stem prostrate or ascending, to 5 cm. long and 2–3 mm. thick. Leaves linear, apparently spirally arranged, congested, 22–38 cm. long and 4.4–5 mm. wide, acute at the apex, with 5 to 12 small teeth, pale dull green when dry, plane, nerves 12 to 15, margin and surface smooth, at the base widening gradually and with a somewhat scarious edge breaking irregularly and ± persisting as fibers. Inflorescence to 20 cm. long, sparsely and irregularly branched, with single clusters at the branching points and a few along the inflorescence, 1 to 3 together at the end, first cluster often only 1 cm. or so above the base; cluster consisting of a large cluster bract to 3 cm. long subtending numerous bracts plus flowers, each flower terminal, it and the younger part of the cluster ensheathed by a bract; pedicel flattened, 3.2–4 mm. long. Flower apparently hermaphroditic; tepals 6, the outer three ovate, greenish, ca. 3.5 mm. long and 1 mm. wide, the inner tepals white, ± elliptic, ca. 3.75 mm. long and 0.75 mm. wide; stamens 6, the filaments connate for the basal 0.5 mm., flattened, narrowly triangular, filaments of stamens opposite the outer whorl of tepals ca. 2.2 mm. long, ± adnate to the tepals for the basal 0.5 mm., filaments of stamens opposite the inner whorl of tepals ca. 2.5 mm. long, adnate to the tepals for the basal 0.7–1 mm., the anthers ca. 1 mm. long, dorsifixed, dehiscence latrorse; ovary ± ovoid, smooth, ca. 1.5 mm. long, 3-locular, ovules 2 per loculus, pendulous, ± superposed; style ca. 1 mm. long; stigma small, capitate. Fruit a loculicidal capsule, surrounded by the persistent tepals at the base, green, usually asymmetrically ovoid, 4–4.7 mm. long and ca. 3.7 mm. across, pointed at the apex, smooth when mature, minutely spiny when young; seeds 1(to 3), slightly flattened-ellipsoidal, brownish, ca. 4.7 mm. long, 3.8 mm. wide and 3 mm. deep, foveate, the testa finely reticulate, the embryo curved, the micropyle facing outward.

DISTRIBUTION. Papuasia, scattered in the northern part (MAP 1).

ADDITIONAL SPECIMENS SEEN. **Papuasia.** IRIAN JAYA. Geelvink Bay: Jappen-Biak, Saroerai near Seroei, *Aet & Idjan* (exp. L. J. van Dijk) *24* (A, K, L). PAPUA NEW GUINEA. New Britain: Mt. Klangal, 40 km. N.N.E. of Gasmata, Kandrian subdistrict, West New Britain, 800 m., *NGF 41283* (A, B, LAE); mapping site at edge of Mengen Massif, Pomio subdistrict, East New Britain, 960 m., *LAE 58742* (A, B, LAE).

ECOLOGY. *Romnalda papuana* is a very locally abundant plant of colline rain forest, growing from 250 to 960 meters altitude. The collections from New Britain were made in forest with much *Castanopsis acuminatissima*, in a creek (*NGF 41283*) or on a dry, stony ridge (*LAE 58742*).

On New Britain *Romnalda papuana* was growing in the same area as a species of *Alpinia* section MYRIOCRATER, which also has long-lived inflorescences.

KEY TO THE PAPUASIAN SPECIES OF LOMANDRA

1. Shrublet to 2 m. tall; leaves dehiscing just above the base, the part remaining becoming recurved and persisting. ..... *L. banksii.*
1. Herb, stem a short underground rhizome; leaves not dehiscing above the base, but the whole leaf gradually withering. ..... *L. multiflora.*

F. von Mueller was the first to record *Lomandra* from Papuasia (Mueller, 1876; as *Xerotes banksii*). This record was based on a sterile specimen collected by J. Orkney (properly Orknie) near the Baxter River (the Mai Kussa, in the Western Province of Papua New Guinea). Lauterbach (1913) and Krause (1925) repeated this report, but it was not until the 1936–37 Archbold Expedition that the species was re-collected by L. J. Brass. In 1966 a second species, here identified as *L. multiflora*, was collected from the Western Province.

Lauterbach (1913) recorded *Lomandra longifolia* Labill. from Java, but *Lomandra* is not included by Backer and Bakhuisen f. (1968) in their *Flora of Java* and is probably not native there. The two species of *Lomandra* from Papuasia appear to be the only two at present known from Malesia.

Lomandra banksii (R. Br.) Lauterb. Bot. Jahrb. **50**: 294. 1913; Krause, Bot. Jahrb. **59**: 554. 1925; *Xerotes banksii* R. Br. Prodr. 1: 263. 1810; F. Mueller, Descr. Notes Papuan Pl. 1. 3: 45. 1876. TYPE: Australia, Queensland, Endeavour River, *Banks & Solander* anno 1770 (holotype, BM).

Undershrub to 2 m. tall; stem 6–7.5 mm. across. Leaves distichous, rather scattered, linear, 25–40 cm. long and 3.5–4.7 mm. across, with (1 to)3 obscure teeth at the apex, pale dull green when dry, plane, nerves 33 to 45, margin minutely scaberulous, broadening somewhat toward the base, at the base with a subpersistent scarious margin splitting irregularly, ca. 0.5 cm. of the leaf persisting and becoming strongly recurved after

the rest abscises. Plants dioecious: staminate and pistillate inflorescences similar, apparently terminal (growth of the stem continued by an axillary bud developed just below the inflorescence), paniculate, once or twice branched, smooth, lowest whorl of branches borne 5–15 cm. above the base, usually at least 2 cm. between whorls, branches to 12 cm. long, perhaps rather shorter in pistillate than in staminate plants. Staminate plants: flower clusters along the stem each subtended by a cluster bract to 1 cm. long, 1- to 7-flowered, the terminal clusters 10- to 20-flowered, apparently lacking cluster bracts; flowers sessile, each ensheathed by two further bractlike structures up to 1 mm. tall; tepals 6, free, the outer three tepals ovate, 2.2–2.5 mm. long and ca. 1.5 mm. wide, the inner three tepals ovate, ca. 3 mm. long and 1 mm. wide; stamens 6, the filaments flattened, filaments of stamens opposite the outer whorl of tepals ca. 1.7 mm. long, adnate to the tepals for ca. 0.5 mm., filaments of stamens opposite the inner whorl of tepals ca. 2.1 mm. long, adnate to the tepals for ca. 1.5 mm., the anthers ca. 0.5 mm. long, dorsifixed, dehiscence latrorse; pistillode prominent, ca. 1.5 mm. long, stigmas not developed. Pistillate plant: flower clusters along the stem each subtended by a thick cluster bract ca. 5 mm. long, 1- to 3-flowered, terminal clusters 5- to 8-flowered, outer flowers subtended by "cluster bracts," inner flowers lacking them; flowers sessile, usually with a single additional ensheathing bractlike structure, sometimes with two; tepals free, the outer tepals ovate, 4.3–4.5 mm. long and ca. 3.2 mm. across, the inner tepals ± triangular, 4.6–4.8 mm. long and ca. 2.8 mm. across, margins incurved; stamens very much as in staminate flowers, but anthers rudimentary; ovary ovoid, 3-angled, ca. 2.7 mm. long and 1.9 mm. across, 3-locular, one ovule per loculus, ovary continuous with the style; style ca. 1.3 mm. long, with three longitudinal ridges; stigma papillate, with three short, retrorse arms. Fruit a loculicidal capsule, surrounded by persistent tepals at the base, ovoid, 8–9 mm. long and 5–7 mm. across, usually 3-seeded, strongly pointed at the apex, the valves with 4 to 5 fine transverse wrinkles per 1 mm.; seeds ellipsoid, slightly curved or not, orange when dry, ca. 5 mm. long and 3–3.5 mm. across, the testa coarsely and irregularly reticulate, the embryo almost straight, the micropyle basal.

DISTRIBUTION. Papua New Guinea, the Western Province, and Australia (Queensland) (MAP 1); ?New Caledonia.

SPECIMEN FROM PAPUASIA EXAMINED: **Papua New Guinea (Papua).** WESTERN: Tarara, Wassi Kussa River, *Brass 8700* (pistillate and carpellate plants: A).

ECOLOGY. *Lomandra banksii* is reported as being an occasional subshrub in dense savannah forests at low altitudes. It was in flower and young fruit when collected in January.

The description of the fruit and seed was taken from *Brass 18512*, collected in the Cape York Peninsula, Queensland, Australia. Agreement between Australian and Papuasian specimens is excellent, and they grow in similar habitats. The staminate inflorescences of *Brass 8700* tend to have alternate, rather than whorled, branching, but this is probably an

abnormality, part of one inflorescence being weakly fasciated. The reports of *Lomandra banksii* from New Caledonia (e.g., Mueller, 1876) should be re-examined.

Lauterbach (*loc. cit.*) was the first to transfer *Xerotes banksii* to *Lomandra*, making the combination three years before Macbride (1916), who is usually given as the author of the combination.

Lomandra multiflora (R. Br.) J. Britten in Banks & Solander, Ill. Bot. Cook's Voy. 3: 95. *pl. 313*. 1905; *Xerotes multiflora* R. Br. Prodr. 1: 262. 1810. TYPE: Australia, *Banks & Solander s.n.* (n.v.).

?Lomandra Ridsdale, Papua New Guinea Sci. Soc. Trans. 8: 22. 1969.

Rhizomatous herb, the rhizome near the surface of the ground, ca. 3 mm. across. Leaves ± distichous, aggregated, linear, up to 72 cm. long and (0.6–)2.5–4 cm. across, rounded to obtuse at the apex, when alive yellowish green, when dry dull greenish brown, inrolled, the nerves (7 to) 15 to 21, the surfaces and margins of the leaf minutely scaberulous, at the base gradually expanded, the margins dark brown, ± scarious, splitting irregularly and not persistent. Plants dioecious. Staminate inflorescence: 50–65 cm. long, scaberulous, especially toward the apex, twice branched the branches whorled, 2–5.5 cm. between the whorls, the lowest whorl 20–30 cm. from the base of the inflorescence, with 6 to 12 branches, the bracts subtending the branches 2–10 mm. long, the branches to 11 cm. long; clusters of flowers borne in whorls of 3 toward the apex of the branches, the cluster bracts to 3 mm. long, the terminal cluster surrounded by ca. 3 cluster bracts; flowers 2 to 4 per cluster, each flower surrounded by 2, very rarely 3, "bracts," the pedicels up to 1 mm. long; flowers greenish yellow; tepals ovate, 6, almost free, the outer three tepals ca. 1 mm. long and 0.7–0.8 mm. across, the inner three tepals ca. 0.8 mm. long and 0.5 mm. across, thicker; stamens 6, the filaments adnate to the tepals for ca. 0.2 mm., the free part of the filaments opposite the outer whorl of tepals very short, that of the filaments opposite the inner whorl up to 0.1 mm. long, the anthers oblong, 0.35–0.45 mm. long, dorsifixed; pistillode minute. Pistillate inflorescence: 28–30 cm. long, scaberulous, unbranched; clusters of flowers in whorls of up to 6, 1–2.5 cm. distant, the cluster bracts to 7.5 mm. long; flowers 2 to 6 per cluster, "bracts" apparently as in staminate flowers; pedicels absent; tepals ovate (persisting at the base of the fruit), the three outer ca. 3.1 mm. long and 2.9 mm. across, the three inner ca. 2.5 mm. long and 1.5 mm. across; ovary and staminodes unknown, but fruit crowned by three persistent, recurved stigmatic lobes. Fruit a loculicidal capsule, at maturity generally with a single seed, asymmetrical, 6–6.5 mm. long, 3.3–4 mm. across and ca. 5 mm. deep, grayish brown when dry (the sutures brown), with distant transverse wrinkles; seeds slightly curved, ellipsoid, 5.5–6 mm. long, 3.3–4 mm. across and 3–3.5 mm. deep, the testa minutely reticulated, the anticlinal cell walls being prominent, the embryo slightly curved, the micropyle basal.

DISTRIBUTION. Papua New Guinea, the Western Province (MAP 1); widespread in Australia.

SPECIMENS FROM PAPUASIA EXAMINED. **Papua New Guinea (Papua).** WESTERN: near Weam, 30 m., *NGF 33573* (staminate: CANB, K, LAE), *NGF 33574* (pistillate: A, CANB, K, LAE); ca. 5 km. W. of Morehead River at lat. 8° 48′ S., 15 m., *Paijmans 304* (staminate: CANB).

ECOLOGY. *Lomandra multiflora* grows in open savannah; specimens with both flowers and fruits have been collected in August.

Although *Lomandra multiflora* is a very variable species, the specimens described above at first sight look completely different from the common form of the species. This latter has a smooth inflorescence axis, pedicels up to 10 mm. or more long, and staminate flowers over 2 mm. long. However, small-flowered specimens from Queensland (e.g., *Brass 18939*, Cape York Peninsula) have pedicels about 3 mm. long, and other specimens with larger flowers may have scaberulous inflorescence axes. Hence the broad circumscription of *L. multiflora* adopted by Bentham (1878) and Lee (1966) is followed.

The description above is taken entirely from the Papuasian specimens.

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